WE CLAIM:

1. A water-dispersible nanoparticle comprising:

(a) an inner core comprised of a semiconductive or metallic material;

(b) a water-insoluble organic coating provided thereon; and

(c) an outer layer of a multiply amphipathic polymer that comprises at least two hydrophobic regions and at least two hydrophilic regions; and

(d) a functional group covalently bound to the polymer through an oxyalkylene linking moiety.

2. The water-dispersible nanoparticle of claim 1, wherein the oxyalkylene linking moiety is composed of 2 to about 20 carbon atoms.

3. The water-dispersible nanoparticle of claim 1, wherein the functional group is selected from amino, cyano, carboxyl, ester, and halocarbonyl groups.

4. The water-dispersible nanoparticle of claim 3, wherein the functional group is an amino group.

5. The water-dispersible nanoparticle of claim 1, wherein the inner core is comprised of a semiconductive material.

6. The water-dispersible nanoparticle of claim 5, wherein the semiconductive material is inorganic.

7. The water-dispersible nanoparticle of claim 6, wherein the semiconductive material is crystalline.

8. The water-dispersible nanoparticle of claim 5, wherein the water-insoluble organic coating is comprised of trioctylphosphine oxide, trioctylphosphine, tributylphosphine, or a mixture thereof.

9. The water-dispersible nanoparticle of claim 5, further including a shell layer between the core and the water-insoluble organic coating.

10. The water-dispersible nanoparticle of claim 9, wherein the shell layer is comprised of a semiconductive material having a band gap energy greater than that of the inner core.

11. The water-dispersible nanoparticle of claim 1, wherein the inner core is comprised of a metallic material.

12. The water-dispersible nanoparticle of claim 11, wherein the water-insoluble organic coating has an affinity for the metallic material.

13. The water-dispersible nanoparticle of claim 12, wherein the water-insoluble organic coating is comprised of a hydrophobic surfactant.

14. The water-dispersible nanoparticle of claim 13, wherein the hydrophobic surfactant is selected from the group consisting of octanethiol, dodecanethiol, dodecylamine, tetraoctylammonium bromide, and mixtures thereof.

15. The water-dispersible nanoparticle of claim 1, wherein the multiply amphipathic polymer is linear or branched.

16. The water-dispersible nanoparticle of claim 15, wherein the multiply amphipathic polymer is branched.

17. The water-dispersible nanoparticle of claim 16, wherein the multiply amphipathic polymer is hyperbranched or dendritic.

18. The water-dispersible nanoparticle of claim 1, wherein the hydrophobic regions of the multiply amphipathic polymer are each comprised of at least one non-ionizable, nonpolar monomer unit.

19. The water-dispersible nanoparticle of claim 1, wherein each of the hydrophobic regions comprise at least one monomer unit selected from the group consisting of ethylene, propylene, alkyl (C_4-C_{12})-substituted ethyleneimine, an alkyl acrylate, a methacrylate, a phenyl acrylate, an alkyl acrylamide, a styrene, a hydrophobically derivatized styrene, a vinyl ether, a vinyl ester, a vinyl halide, and a combination thereof.

20. The water-dispersible nanoparticle of claim 19, wherein the hydrophobic regions comprise at least one monomer unit selected from an alkyl acrylate, an alkyl methacrylate, an alkyl acrylamide, and a mixture thereof.

21. The water-dispersible nanoparticle of claim 1, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise at least one monomer unit containing an ionizable or polar moiety.

22. The water-dispersible nanoparticle of claim 21, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable moiety.

23. The water-dispersible nanoparticle of claim 22, wherein the ionizable moiety is selected from the group consisting of carboxylic acid, sulfonic acid, phosphonic acid, and amine substituents.

24. The water-dispersible nanoparticle of claim 18, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable or polar moiety.

25. The water-dispersible nanoparticle of claim 24, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable moiety.

26. The water-dispersible nanoparticle of claim 25, wherein the ionizable moiety is selected from the group consisting of carboxylic acid, sulfonic acid, phosphonic acid, and an amine substituent.

27. The water-dispersible nanoparticle of claim 1, wherein the hydrophilic regions of the multiply amphipathic polymer t each comprise at least one monomer unit selected from the group consisting of a water-soluble ethylenically unsaturated C_3-C_6 carboxylic acid, an allylamine, an inorganic acid addition salt of an allylamine, a di-C_1-C_3-alkylamino-C_2-C_6-alkyl acrylate, a methacrylate, an olefinically unsaturated nitrile, a diolefinically unsaturated monomer, N-vinyl pyrrolidone, N-vinyl formamide, an acrylamide, a lower alkyl-substituted acrylamide, a lower alkoxy-substituted acrylamide, N-vinylimidazole, N-vinylimidazoline, a styrene sulfonic acid and an alkylene oxide.

28. The water-dispersible nanoparticle of claim 27, wherein the hydrophilic regions each comprise at least one monomer unit selected from the group consisting of acrylic acid, methacrylic acid, styrene sulfonic acid, acrylamide and methacrylamide.

29. The water-dispersible nanoparticle of claim 1, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise a vinyl monomer substituted with at least one hydrophilic moiety selected from the group consisting of a carboxylate, a thiocarboxylate, an amide, an imide, a hydrazine, a sulfonate, a sulfoxide, a sulfone, a sulfite, a phosphate, a phosphonate, a phosphonium, an alcohol, a thiol, a nitrate, an amine, an ammonium, and an alkyl ammonium group $-[NHR^1R^2]^+$, wherein R^1 and R^2 are alkyl substituents.

30. The water-dispersible nanoparticle of claim 29, wherein the hydrophilic moiety is directly bound to a carbon atom in the polymer backbone of the multiply amphipathic polymer.

31. The water-dispersible nanoparticle of claim 29, wherein the hydrophilic moiety is bound to a carbon atom in the backbone of the multiply amphipathic polymer through a linkage selected from the group consisting of alkylene, alkenylene, heteroalkylene, heteroalkenylene, arylene, heteroarylene, alkarylene, and aralkylene.

32. The water-dispersible nanoparticle of claim 1, wherein the multiply amphipathic polymer is a copolymer of a hydrophilic monomer selected from the group consisting of acrylic acid, methacrylic acid and combinations thereof, with at least one hydrophobic alkyl (C_6-C_{12}) acrylamide monomer.

33. The water-dispersible nanoparticle of claim 32, wherein the multiply amphipathic polymer is poly(acrylic acid-co-octylacrylamide).

34. The water-dispersible nanoparticle of claim 1, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 500 to 50,000.

35. The water-dispersible nanoparticle of claim 34, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 1000 to 10,000.

36. The water-dispersible nanoparticle of claim 35, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 1000 to 5000.

37. The water-dispersible nanoparticle of claim 33, wherein the poly(acrylic acid-co-octylacrylamide) has a molecular weight in the range of approximately 1000 to 5000.

38. The water-dispersible nanoparticle of claim 1, wherein the hydrophobic regions represent in the range of approximately 25 wt.% to 90 wt.% of the multiply amphipathic polymer.

39. The water-dispersible nanoparticle of claim 1, wherein the multiply amphipathic polymer is a polypeptide in which the hydrophobic regions are comprised of at least one hydrophobic amino acid and the hydrophilic regions are comprised of at least one hydrophilic amino acid.

40. The water-dispersible nanoparticle of claim 1, wherein the multiply amphipathic polymer is crosslinked.

41. A composition comprising a plurality of water-dispersible nanoparticles each comprising:

(a) an inner core comprised of a semiconductive or metallic material;

(b) a water-insoluble organic coating provided thereon; and

(c) an outer layer of a multiply amphipathic polymer that comprises at least two hydrophobic regions and at least two hydrophilic regions; and

(d) a functional group covalently bound to the polymer through an oxyalkylene linking moiety.

42. The composition of claim 41, wherein the inner cores of the nanoparticles are members of a monodisperse particle population.

43. The composition of claim 42, wherein the monodisperse particle population is characterized in that when irradiated the population emits light in a bandwidth in the range of approximately 20 nm to 60 nm full width at half maximum (FWHM).

44. The composition of claim 43, wherein the monodisperse particle population is characterized in that when irradiated the population emits light in a bandwidth in the range of approximately 20 nm to 40 nm full width at half maximum (FWHM).

45. The composition of claim 42, wherein the monodisperse particle population is characterized in that it exhibits no more than about a 10% rms deviation in the diameter of the inner core.

46. The composition of claim 45 wherein the monodisperse particle population is characterized in that it exhibits no more than about a 5% rms deviation in the diameter of the inner core.

47. The composition of claim 41, wherein the oxyalkylene linking moiety is composed of 2 to about 20 carbon atoms.

48. The composition of claim 41, wherein the functional group is selected from amino, cyano, carboxyl, ester, and halocarbonyl groups.

49. The composition of claim 48 wherein the functional group is an amino group.

50. The composition of claim 41, wherein the inner core is comprised of a semiconductive material.

51. The composition of claim 50, wherein the semiconductive material is inorganic.

52. The composition of claim 51, wherein the semiconductive material is crystalline.

53. The composition of claim 50, wherein the water-insoluble organic coating is comprised of trioctylphosphine oxide, trioctylphosphine, tributylphosphine, or a mixture thereof.

54. The composition of claim 50, further including a shell layer between the core and the water-insoluble organic coating.

55. The composition of claim 54, wherein the shell layer is comprised of a semiconductive material having a band gap energy greater than that of the inner core.

56. The composition of claim 41, wherein the inner core is comprised of a metallic material.

57. The composition of claim 56, wherein the water-insoluble organic coating has an affinity for the metallic material.

58. The composition of claim 57, wherein the water-insoluble organic coating is comprised of a hydrophobic surfactant.

59. The composition of claim 58, wherein the hydrophobic surfactant is selected from the group consisting of octanethiol, dodecanethiol, dodecylamine, tetraoctylammonium bromide, and mixtures thereof.

60. The composition of claim 41, wherein the multiply amphipathic polymer is linear or branched.

61. The composition of claim 60, wherein the multiply amphipathic polymer is branched.

62. The composition of claim 61, wherein the multiply amphipathic polymer is hyperbranched or dendritic.

63. The composition of claim 41, wherein the hydrophobic regions of the multiply amphipathic polymer are each comprised of at least one non-ionizable, nonpolar monomer unit.

64. The composition of claim 41, wherein each of the hydrophobic regions comprise at least one monomer unit selected from the group consisting of ethylene, propylene, alkyl (C_4-C_{12})-substituted ethyleneimine, an alkyl acrylate, a methacrylate, a phenyl acrylate, an alkyl acrylamide, a styrene, a hydrophobically derivatized styrene, a vinyl ether, a vinyl ester, a vinyl halide, and a combination thereof.

65. The composition of claim 58, wherein the hydrophobic regions comprise at least one monomer unit selected from an alkyl acrylate, an alkyl methacrylate, an alkyl acrylamide, and a mixture thereof.

66. The composition of claim 41, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise at least one monomer unit containing an ionizable or polar moiety.

67. The composition of claim 66, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable moiety.

68. The composition of claim 67, wherein the ionizable moiety is selected from the group consisting of carboxylic acid, sulfonic acid, phosphonic acid, and amine substituents.

69. The composition of claim 63, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable or polar moiety.

70. The composition of claim 69, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable moiety.

71. The composition of claim 70, wherein the ionizable moiety is selected from the group consisting of carboxylic acid, sulfonic acid, phosphonic acid, and an amine substituent.

72. The composition of claim 41, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise at least one monomer unit selected from the group consisting of a water-soluble ethylenically unsaturated C_3-C_6 carboxylic acid, an allylamine, an inorganic acid addition salt of an allylamine, a di-C_1-C_3-alkylamino-C_2-C_6-alkyl acrylate, a methacrylate, an olefinically unsaturated nitrile, a diolefinically unsaturated monomer, N-vinyl pyrrolidone, N-vinyl formamide, an acrylamide, a lower alkyl-substituted acrylamide, a lower alkoxy-substituted acrylamide, N-vinylimidazole, N-vinylimidazoline, a styrene sulfonic acid and an alkylene oxide.

73. The composition of claim 72, wherein the hydrophilic regions each comprise at least one monomer unit selected from the group consisting of acrylic acid, methacrylic acid, styrene sulfonic acid, acrylamide and methacrylamide.

74. The composition of claim 41, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise a vinyl monomer substituted with at least one hydrophilic moiety selected from the group consisting of a carboxylate, a thiocarboxylate, an amide, an imide, a hydrazine, a sulfonate, a sulfoxide, a sulfone, a sulfite, a phosphate, a phosphonate, a phosphonium, an alcohol, a thiol, a nitrate, an amine, an ammonium, and an alkyl ammonium group $-[NHR^1R^2]^+$, wherein R^1 and R^2 are alkyl substituents.

75. The composition of claim 74, wherein the hydrophilic moiety is directly bound to a carbon atom in the backbone of the multiply amphipathic polymer.

76. The composition of claim 74, wherein the hydrophilic moiety is bound to a carbon atom in the backbone of the multiply amphipathic polymer through a linkage selected from the group consisting of alkylene, alkenylene, heteroalkylene, heteroalkenylene, arylene, heteroarylene, alkarylene, and aralkylene.

77. The composition of claim 41, wherein the multiply amphipathic polymer is a copolymer of a hydrophilic monomer selected from the group consisting of acrylic acid, methacrylic acid and combinations thereof, with at least one hydrophobic alkyl (C_6-C_{12}) acrylamide monomer.

78. The composition of claim 71, wherein the multiply amphipathic polymer is poly(acrylic acid-co-octylacrylamide).

79. The composition of claim 41, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 500 to 50,000.

80. The composition of claim 79, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 1000 to 10,000.

81. The composition of claim 80, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 1000 to 5000.

82. The composition of claim 78, wherein the poly(acrylic acid-co-octylacrylamide) has a molecular weight in the range of approximately 1000 to 5000.

83. The composition of claim 41, wherein the hydrophobic regions of the multiply amphipathic polymer represent in the range of approximately 25 wt.% to 90 wt.% of the polymer.

84. The composition of claim 41, wherein the multiply amphipathic polymer is a polypeptide in which the hydrophobic regions are comprised of at least one hydrophobic amino acid and the hydrophilic regions are comprised of at least one hydrophilic amino acid.

85. The composition of claim 41, wherein the multiply amphipathic polymer is crosslinked.

86. A conjugate of an affinity molecule and a water-dispersible nanoparticle, wherein the nanoparticle comprises (a) an inner core comprised of a semiconductive or metallic material, (b) a water-insoluble organic coating provided thereon, (c) an outer layer of a multiply amphipathic polymer having at least two hydrophobic regions and at least two hydrophilic regions, and (d) a functional group covalently linked to the polymer, and further wherein the affinity molecule is bound to the functional group through an oxyalkylene linking moiety.

87. The conjugate of claim 86, wherein the affinity molecule is selected so as to specifically bind to a biological target molecule.

88. The conjugate of claim 87, wherein the affinity molecule is selected from the group consisting of an antigen, hapten, antibody, antibody fragment, hormone, hormone binding protein, enzyme, enzyme inhibitor, nucleic acid, nucleotide, oligonucleotide, polynucleotide, receptor agonist, and receptor antagonist.

89. The conjugate of claim 87, wherein the affinity molecule specifically binds to the biological target molecule through noncovalent interaction.

90. The conjugate of claim 89, wherein the affinity molecule specifically binds to the biological target molecule through noncovalent interaction.

91. The conjugate of claim 86, wherein the oxyalkylene linking moiety is composed of 2 to about 20 carbon atoms.

92. The conjugate of claim 86, wherein the functional group is selected from amino, cyano, carboxyl, ester, and halocarbonyl groups.

93. The conjugate of claim 92, wherein the functional group is an amino group.

94. The water-dispersible nanoparticle of claim 86, wherein the inner core is comprised of a semiconductive material.

95. The conjugate of claim 94, wherein the semiconductive material is inorganic.

96. The conjugate of claim 95, wherein the semiconductive material is crystalline.

97. The conjugate of claim 94, wherein the water-insoluble organic coating is comprised of trioctylphosphine oxide, trioctylphosphine, tributylphosphine, or a mixture thereof.

98. The conjugate of claim 94, further including a shell layer between the core and the water-insoluble organic coating.

99. The conjugate of claim 98, wherein the shell layer is comprised of a semiconductive material having a band gap energy greater than that of the inner core.

100. The conjugate of claim 86, wherein the inner core is comprised of a metallic material.

101. The conjugate of claim 100, wherein the water-insoluble organic coating has an affinity for the metallic material.

102. The conjugate of claim 101, wherein the water-insoluble organic coating is comprised of a hydrophobic surfactant.

103. The conjugate of claim 102, wherein the hydrophobic surfactant is selected from the group consisting of octanethiol, dodecanethiol, dodecylamine, tetraoctylammonium bromide, and mixtures thereof.

104. The conjugate of claim 86, wherein the multiply amphipathic polymer is linear or branched.

105. The conjugate of claim 104, wherein the multiply amphipathic polymer is branched.

106. The conjugate of claim 105, wherein the multiply amphipathic polymer is hyperbranched or dendritic.

107. The conjugate of claim 86, wherein the hydrophobic regions of the multiply amphipathic polymer are each comprised of at least one non-ionizable, nonpolar monomer unit.

108. The conjugate of claim 86, wherein each of the hydrophobic regions comprise at least one monomer unit selected from the group consisting of ethylene, propylene, alkyl (C_4-C_{12})-substituted ethyleneimine, an alkyl acrylate, a methacrylate, a phenyl acrylate, an alkyl acrylamide,

a styrene, a hydrophobically derivatized styrene, a vinyl ether, a vinyl ester, a vinyl halide, and a combination thereof.

109. The conjugate of claim 108, wherein the hydrophobic regions comprise at least one monomer unit selected from an alkyl acrylate, an alkyl methacrylate, an alkyl acrylamide, and a mixture thereof.

110. The conjugate of claim 86, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise at least one monomer unit containing an ionizable or polar moiety.

111. The conjugate of claim 110, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable moiety.

112. The conjugate of claim 111, wherein the ionizable moiety is selected from the group consisting of carboxylic acid, sulfonic acid, phosphonic acid, and amine substituents.

113. The conjugate of claim 107, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable or polar moiety.

114. The conjugate of claim 113, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable moiety.

115. The conjugate of claim 114, wherein the ionizable moiety is selected from the group consisting of carboxylic acid, sulfonic acid, phosphonic acid, and an amine substituent.

116. The conjugate of claim 86, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise at least one monomer unit selected from the group consisting of a water-soluble ethylenically unsaturated C_3-C_6 carboxylic acid, an allylamine, an inorganic acid addition salt of an allylamine, a di-C_1-C_3-alkylamino-C_2-C_6-alkyl acrylate, a methacrylate, an olefinically unsaturated nitrile, a diolefinically unsaturated monomer, N-vinyl pyrrolidone, N-vinyl formamide, an acrylamide, a lower alkyl-substituted acrylamide, a lower alkoxy-substituted acrylamide, N-vinylimidazole, N-vinylimidazoline, a styrene sulfonic acid and an alkylene oxide.

117. The conjugate of claim 116, wherein the hydrophilic regions each comprise at least one monomer unit selected from the group consisting of acrylic acid, methacrylic acid, styrene sulfonic acid, acrylamide and methacrylamide.

118. The conjugate of claim 86, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise a vinyl monomer substituted with at least one hydrophilic moiety selected from the group consisting of a carboxylate, a thiocarboxylate, an amide, an imide, a hydrazine, a sulfonate, a sulfoxide, a sulfone, a sulfite, a phosphate, a phosphonate, a phosphonium, an alcohol, a thiol, a nitrate, an amine, an ammonium, and an alkyl ammonium group $-[NHR^1R^2]^+$, wherein R^1 and R^2 are alkyl substituents.

119. The conjugate of claim 118, wherein the hydrophilic moiety is directly bound to a carbon atom in the backbone of the multiply amphipathic polymer.

120. The conjugate of claim 118, wherein the hydrophilic moiety is bound to a carbon atom in the backbone of the multiply amphipathic polymer through a linkage selected from the group consisting of alkylene, alkenylene, heteroalkylene, heteroalkenylene, arylene, heteroarylene, alkarylene, and aralkylene.

121. The conjugate of claim 86, wherein the multiply amphipathic polymer is a copolymer of a hydrophilic monomer selected from the group consisting of acrylic acid, methacrylic acid and combinations thereof, with at least one hydrophobic alkyl (C_6-C_{12}) acrylamide monomer.

122. The conjugate of claim 121, wherein the multiply amphipathic polymer is poly(acrylic acid-co-octylacrylamide).

123. The conjugate of claim 86, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 500 to 50,000.

124. The conjugate of claim 123, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 1000 to 10,000.

125. The conjugate of claim 124, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 1000 to 5000.

126. The conjugate of claim 122, wherein the poly(acrylic acid-co-octylacrylamide) has a molecular weight in the range of approximately 1000 to 5000.

127. The conjugate of claim 86, wherein the hydrophobic regions represent in the range of approximately 25 wt.% to 90 wt.% of the multiply amphipathic polymer.

128. The conjugate of claim 86, wherein the multiply amphipathic polymer is a polypeptide in which the hydrophobic regions are comprised of at least one hydrophobic amino acid and the hydrophilic regions are comprised of at least one hydrophilic amino acid.

129. The conjugate of claim 86, wherein the multiply amphipathic polymer is crosslinked.

130. A composition comprising a plurality of nanoparticle conjugates each composed of a water-dispersible nanoparticle and an affinity molecule, wherein each water-dispersible nanoparticle comprises (a) an inner core comprised of a semiconductive or metallic material, (b) a water-insoluble organic coating provided thereon, (c) an outer layer of a multiply amphipathic polymer having at least two hydrophobic regions and at least two hydrophilic regions, and (d) a functional group covalently linked to the polymer, and further wherein the affinity molecule is bound to the functional group through an oxyalkylene linking moiety.

131. The composition of claim 130, wherein the inner cores of the nanoparticles are members of a monodisperse particle population.

132. The composition of claim 131, wherein the monodisperse particle population is characterized in that when irradiated the population emits light in a bandwidth in the range of approximately 20 nm to 60 nm full width at half maximum (FWHM).

133. The composition of claim 132, wherein the monodisperse particle population is characterized in that when irradiated the population emits light in a bandwidth in the range of approximately 20 nm to 40 nm full width at half maximum (FWHM).

134. The composition of claim 131, wherein the monodisperse particle population is characterized in that it exhibits no more than about a 10% rms deviation in the diameter of the inner core.

135. The composition of claim 134, wherein the monodisperse particle population is characterized in that it exhibits no more than about a 5% rms deviation in the diameter of the inner core.

136. The composition of claim 130, wherein the affinity molecule is selected so as to specifically bind to a biological target molecule.

137. The composition of claim 136, wherein the affinity molecule is selected from the group consisting of an antigen, hapten, antibody, antibody fragment, hormone, hormone binding protein, enzyme, enzyme inhibitor, nucleic acid, nucleotide, oligonucleotide, polynucleotide, receptor agonist, and receptor antagonist.

138. The composition of claim 136, wherein the affinity molecule specifically binds to the biological target molecule through noncovalent interaction.

139. The composition of claim 138, wherein the affinity molecule specifically binds to the biological target molecule through noncovalent interaction.

140. The composition of claim 130, wherein the oxyalkylene linking moiety is composed of 2 to about 20 carbon atoms.

141. The composition of claim 130, wherein the functional group is selected from amino, cyano, carboxyl, ester, and halocarbonyl groups.

142. The composition of claim 143, wherein the functional group is an amino group.

143. The composition of claim 130, wherein the inner core is comprised of a semiconductive material.

144. The composition of claim 143, wherein the semiconductive material is inorganic.

145. The composition of claim 144, wherein the semiconductive material is crystalline.

146. The composition of claim 143, wherein the water-insoluble organic coating is comprised of trioctylphosphine oxide, trioctylphosphine, tributylphosphine, or a mixture thereof.

147. The composition of claim 143, further including a shell layer between the core and the water-insoluble organic coating.

148. The composition of claim 147, wherein the shell layer is comprised of a semiconductive material having a band gap energy greater than that of the inner core.

149. The composition of claim 130, wherein the inner core is comprised of a metallic material.

150. The composition of claim 149, wherein the water-insoluble organic coating has an affinity for the metallic material.

151. The composition of claim 150, wherein the water-insoluble organic coating is comprised of a hydrophobic surfactant.

152. The composition of claim 151, wherein the hydrophobic surfactant is selected from the group consisting of octanethiol, dodecanethiol, dodecylamine, tetraoctylammonium bromide, and mixtures thereof.

153. The composition of claim 130, wherein the multiply amphipathic polymer is linear or branched.

154. The composition of claim 143, wherein the polymer is branched.

155. The composition of claim 154, wherein the polymer is hyperbranched or dendritic.

156. The composition of claim 130, wherein the hydrophobic regions of the multiply amphipathic polymer are each comprised of at least one non-ionizable, nonpolar monomer unit.

157. The composition of claim 130, wherein each of the hydrophobic regions comprise at least one monomer unit selected from the group consisting of ethylene, propylene, alkyl (C_4-C_{12})-substituted ethyleneimine, an alkyl acrylate, a methacrylate, a phenyl acrylate, an alkyl acrylamide, a styrene, a hydrophobically derivatized styrene, a vinyl ether, a vinyl ester, a vinyl halide, and a combination thereof.

158. The composition of claim 157, wherein the hydrophobic regions comprise at least one monomer unit selected from an alkyl acrylate, an alkyl methacrylate, an alkyl acrylamide, and a mixture thereof.

159. The composition of claim 130, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise at least one monomer unit containing an ionizable or polar moiety.

160. The composition of claim 159, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable moiety.

161. The composition of claim 160, wherein the ionizable moiety is selected from the group consisting of carboxylic acid, sulfonic acid, phosphonic acid, and amine substituents.

162. The composition of claim 156, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable or polar moiety.

163. The composition of claim 162, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable moiety.

164. The composition of claim 163, wherein the ionizable moiety is selected from the group consisting of carboxylic acid, sulfonic acid, phosphonic acid, and an amine substituent.

165. The composition of claim 130, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise at least one monomer unit selected from the group consisting of a water-soluble ethylenically unsaturated C_3-C_6 carboxylic acid, an allylamine, an inorganic acid addition salt of an allylamine, a di-C_1-C_3-alkylamino-C_2-C_6-alkyl acrylate, a methacrylate, an olefinically unsaturated nitrile, a diolefinically unsaturated monomer, N-vinyl pyrrolidone, N-vinyl formamide, an acrylamide, a lower alkyl-substituted acrylamide, a lower alkoxy-substituted acrylamide, N-vinylimidazole, N-vinylimidazoline, a styrene sulfonic acid and an alkylene oxide.

166. The composition of claim 165, wherein the hydrophilic regions each comprise at least one monomer unit selected from the group consisting of acrylic acid, methacrylic acid, styrene sulfonic acid, acrylamide and methacrylamide.

167. The composition of claim 130, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise a vinyl monomer substituted with at least one hydrophilic moiety selected from the group consisting of a carboxylate, a thiocarboxylate, an amide, an imide, a hydrazine, a sulfonate, a sulfoxide, a sulfone, a sulfite, a phosphate, a phosphonate, a phosphonium, an alcohol, a thiol, a nitrate, an amine, an ammonium, and an alkyl ammonium group $-[NHR^1R^2]^+$, wherein R^1 and R^2 are alkyl substituents.

168. The composition of claim 167, wherein the hydrophilic moiety is directly bound to a carbon atom in the backbone of the multiply amphipathic polymer.

169. The composition of claim 167, wherein the hydrophilic moiety is bound to a carbon atom in the backbone of the multiply amphipathic polymer through a linkage selected from the group consisting of alkylene, alkenylene, heteroalkylene, heteroalkenylene, arylene, heteroarylene, alkarylene, and aralkylene.

170. The composition of claim 130, wherein the multiply amphipathic polymer is a copolymer of a hydrophilic monomer selected from the group consisting of acrylic acid, methacrylic acid and combinations thereof, with at least one hydrophobic alkyl (C_6-C_{12}) acrylamide monomer.

171. The composition of claim 170, wherein the multiply amphipathic polymer is poly(acrylic acid-co-octylacrylamide).

172. The composition of claim 130, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 500 to 50,000.

173. The composition of claim 172, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 1000 to 10,000.

174. The composition of claim 173, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 1000 to 5000.

175. The composition of claim 171, wherein the poly(acrylic acid-co-octylacrylamide) has a molecular weight in the range of approximately 1000 to 5000.

176. The composition of claim 130, wherein the hydrophobic regions represent in the range of approximately 25 wt.% to 90 wt.% of the multiply amphipathic polymer.

177. The composition of claim 130, wherein the multiply amphipathic polymer is a polypeptide in which the hydrophobic regions are comprised of at least one hydrophobic amino acid and the hydrophilic regions are comprised of at least one hydrophilic amino acid.

178. The composition of claim 130, wherein the multiply amphipathic polymer is crosslinked.

179. A nanoparticle conjugate comprising:

(a) a water-dispersible nanoparticle and an affinity molecule that serves as a first member of a binding pair, wherein the nanoparticle comprises (i) an inner core comprised of a semiconductive or metallic material, (ii) a water-insoluble organic coating provided thereon, (iii) an outer layer of a multiply amphipathic polymer having at least two hydrophobic regions and at least two hydrophilic regions, and (iv) a functional group covalently linked to the polymer, and further wherein the affinity molecule is bound to the functional group through an oxyalkylene linking moiety; and

(b) a second member of the binding pair associated with the first member through either covalent or noncovalent interaction.

180. The conjugate of claim 179, wherein the affinity molecule is selected from the group consisting of an antigen, hapten, antibody, antibody fragment, hormone, hormone binding protein, enzyme, enzyme inhibitor, nucleic acid, nucleotide, oligonucleotide, polynucleotide, receptor agonist, and receptor antagonist.

181. The conjugate of claim 179, wherein the first and second members of the binding pair are selected from the group consisting of: antigen and antibody; antigen and antibody fragment; hapten and antibody; hapten and antibody fragment; biotin and avidin; biotin and streptavidin; hormone and hormone binding protein; receptor agonist and receptor; receptor antagonist and receptor; IgG and protein A; lectin and carbohydrate; enzyme and enzyme cofactor; enzyme and enzyme inhibitor; and complementary oligonucleotides.

182. The conjugate of claim 179, wherein the second member of the binding pair is associated with the first member of the binding pair through a covalent bond.

183. The conjugate of claim 179, wherein the second member of the binding pair is associated with the first member of the binding pair through a noncovalent bond.

184. The conjugate of claim 179, wherein the oxyalkylene linking moiety is composed of 2 to about 20 carbon atoms.

185. The conjugate of claim 179, wherein the functional group is selected from amino, cyano, carboxyl, ester, and halocarbonyl groups.

186. The conjugate of claim 185, wherein the functional group is an amino group.

187. The conjugate of claim 179, wherein the inner core is comprised of a semiconductive material.

188. The conjugate of claim 187, wherein the semiconductive material is inorganic.

189. The conjugate of claim 188, wherein the semiconductive material is crystalline.

190. The conjugate of claim 187, wherein the water-insoluble organic coating is comprised of trioctylphosphine oxide, trioctylphosphine, tributylphosphine, or a mixture thereof.

191. The conjugate of claim 187, further including a shell layer between the core and the water-insoluble organic coating.

192. The conjugate of claim 191, wherein the shell layer is comprised of a semiconductive material having a band gap energy greater than that of the inner core.

193. The conjugate of claim 179, wherein the inner core is comprised of a metallic material.

194. The conjugate of claim 193, wherein the water-insoluble organic coating has an affinity for the metallic material.

195. The conjugate of claim 194, wherein the water-insoluble organic coating is comprised of a hydrophobic surfactant.

196. The conjugate of claim 195, wherein the hydrophobic surfactant is selected from the group consisting of octanethiol, dodecanethiol, dodecylamine, tetraoctylammonium bromide, and mixtures thereof.

197. The conjugate of claim 179, wherein the multiply amphipathic polymer is linear or branched.

198. The conjugate of claim 197, wherein the multiply amphipathic polymer is branched.

199. The conjugate of claim 198, wherein the multiply amphipathic polymer is hyperbranched or dendritic.

200. The conjugate of claim 179, wherein the hydrophobic regions of the multiply amphipathic polymer are each comprised of at least one non-ionizable, nonpolar monomer unit.

201. The conjugate of claim 179, wherein each of the hydrophobic regions comprise at least one monomer unit selected from the group consisting of ethylene, propylene, alkyl (C_4-C_{12})-substituted ethyleneimine, an alkyl acrylate, a methacrylate, a phenyl acrylate, an alkyl acrylamide, a styrene, a hydrophobically derivatized styrene, a vinyl ether, a vinyl ester, a vinyl halide, and a combination thereof.

202. The conjugate of claim 201, wherein the hydrophobic regions comprise at least one monomer unit selected from an alkyl acrylate, an alkyl methacrylate, an alkyl acrylamide, and a mixture thereof.

203. The conjugate of claim 179, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise at least one monomer unit containing an ionizable or polar moiety.

204. The conjugate of claim 203, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable moiety.

205. The conjugate of claim 204, wherein the ionizable moiety is selected from the group consisting of carboxylic acid, sulfonic acid, phosphonic acid, and amine substituents.

206. The conjugate of claim 200, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable or polar moiety.

207. The conjugate of claim 206, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable moiety.

208. The conjugate of claim 207, wherein the ionizable moiety is selected from the group consisting of carboxylic acid, sulfonic acid, phosphonic acid, and an amine substituent.

209. The conjugate of claim 179, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise at least one monomer unit selected from the group consisting of a water-soluble ethylenically unsaturated C_3-C_6 carboxylic acid, an allylamine, an inorganic acid addition salt of an allylamine, a di-C_1-C_3-alkylamino-C_2-C_6-alkyl acrylate, a methacrylate, an olefinically unsaturated nitrile, a diolefinically unsaturated monomer, N-vinyl pyrrolidone, N-vinyl formamide, an acrylamide, a lower alkyl-substituted acrylamide, a lower alkoxy-substituted acrylamide, N-vinylimidazole, N-vinylimidazoline, a styrene sulfonic acid and an alkylene oxide.

210. The conjugate of claim 209, wherein the hydrophilic regions each comprise at least one monomer unit selected from the group consisting of acrylic acid, methacrylic acid, styrene sulfonic acid, acrylamide and methacrylamide.

211. The conjugate of claim 179, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise a vinyl monomer substituted with at least one hydrophilic moiety selected from the group consisting of a carboxylate, a thiocarboxylate, an amide, an imide, a hydrazine, a sulfonate, a sulfoxide, a sulfone, a sulfite, a phosphate, a phosphonate, a phosphonium, an alcohol, a thiol, a nitrate, an amine, an ammonium, and an alkyl ammonium group $-[NHR^1R^2]^+$, wherein R^1 and R^2 are alkyl substituents.

212. The conjugate of claim 211, wherein the hydrophilic moiety is directly bound to a carbon atom in the backbone of the multiply amphipathic polymer.

213. The conjugate of claim 211, wherein the hydrophilic moiety is bound to a carbon atom in the backbone of the multiply amphipathic polymer through a linkage selected from the group consisting of alkylene, alkenylene, heteroalkylene, heteroalkenylene, arylene, heteroarylene, alkarylene, and aralkylene.

214. The conjugate of claim 179, wherein the multiply amphipathic polymer is a copolymer of a hydrophilic monomer selected from the group consisting of acrylic acid, methacrylic acid and combinations thereof, with at least one hydrophobic alkyl (C_6-C_{12}) acrylamide monomer.

215. The conjugate of claim 214, wherein the multiply amphipathic polymer is poly(acrylic acid-co-octylacrylamide).

216. The conjugate of claim 179, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 500 to 50,000.

217. The conjugate of claim 216, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 1000 to 10,000.

218. The conjugate of claim 217, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 1000 to 5000.

219. The conjugate of claim 215, wherein the poly(acrylic acid-co-octylacrylamide) has a molecular weight in the range of approximately 1000 to 5000.

220. The conjugate of claim 179, wherein the hydrophobic regions represent in the range of approximately 25 wt.% to 90 wt.% of the multiply amphipathic polymer.

221. The conjugate of claim 179, wherein the multiply amphipathic polymer is a polypeptide in which the hydrophobic regions are comprised of at least one hydrophobic amino acid and the hydrophilic regions are comprised of at least one hydrophilic amino acid.

222. The conjugate of claim 179, wherein the multiply amphipathic polymer is crosslinked.

223. A composition comprising a plurality of nanoparticle conjugates each comprising:

(a) a water-dispersible nanoparticle and an affinity molecule that serves as a first member of a binding pair, wherein the nanoparticle comprises (i) an inner core comprised of a semiconductive or metallic material, (ii) a water-insoluble organic coating provided thereon, (iii) an outer layer of a multiply amphipathic polymer having at least two hydrophobic regions and at least two hydrophilic regions, and (iv) a functional group covalently linked to the polymer, and

further wherein the affinity molecule is bound to the functional group through an oxyalkylene linking moiety; and

(b) a second member of the binding pair associated with the first member through either covalent or noncovalent interaction.

224. The composition of claim 223, wherein the inner cores of the nanoparticles are members of a monodisperse particle population.

225. The composition of claim 224, wherein the monodisperse particle population is characterized in that when irradiated the population emits light in a bandwidth in the range of approximately 20 nm to 60 nm full width at half maximum (FWHM).

226. The composition of claim 225, wherein the monodisperse particle population is characterized in that when irradiated the population emits light in a bandwidth in the range of approximately 20 nm to 40 nm full width at half maximum (FWHM).

227. The composition of claim 224, wherein the monodisperse particle population is characterized in that it exhibits no more than about a 10% rms deviation in the diameter of the inner core.

228. The composition of claim 227, wherein the monodisperse particle population is characterized in that it exhibits no more than about a 5% rms deviation in the diameter of the inner core.

229. The composition of claim 223, wherein the affinity molecule is selected from the group consisting of an antigen, hapten, antibody, antibody fragment, hormone, hormone binding protein, enzyme, enzyme inhibitor, nucleic acid, nucleotide, oligonucleotide, polynucleotide, receptor agonist, and receptor antagonist.

230. The composition of claim 223, wherein the first and second members of the binding pair are selected from the group consisting of: antigen and antibody; antigen and antibody fragment; hapten and antibody; hapten and antibody fragment; biotin and avidin; biotin and streptavidin; hormone and hormone binding protein; receptor agonist and receptor; receptor antagonist and receptor; IgG and protein A; lectin and carbohydrate; enzyme and enzyme cofactor; enzyme and enzyme inhibitor; and complementary oligonucleotides.

231. The composition of claim 223, wherein the second member of the binding pair is associated with the first member of the binding pair through a covalent bond.

232. The composition of claim 223, wherein the second member of the binding pair is associated with the first member of the binding pair through a noncovalent bond.

233. The composition of claim 223, wherein the oxyalkylene linking moiety is composed of 2 to about 20 carbon atoms.

234. The composition of claim 223, wherein the functional group is selected from amino, cyano, carboxyl, ester, and halocarbonyl groups.

235. The composition of claim 234, wherein the functional group is an amino group.

236. The composition of claim 223, wherein the inner core is comprised of a semiconductive material.

237. The composition of claim 236, wherein the semiconductive material is inorganic.

238. The composition of claim 237, wherein the semiconductive material is crystalline.

239. The composition of claim 236, wherein the water-insoluble organic coating is comprised of trioctylphosphine oxide, trioctylphosphine, tributylphosphine, or a mixture thereof.

240. The composition of claim 236, further including a shell layer between the core and the water-insoluble organic coating.

241. The composition of claim 240, wherein the shell layer is comprised of a semiconductive material having a band gap energy greater than that of the inner core.

242. The composition of claim 223, wherein the inner core is comprised of a metallic material.

243. The composition of claim 242, wherein the water-insoluble organic coating has an affinity for the metallic material.

244. The composition of claim 243, wherein the water-insoluble organic coating is comprised of a hydrophobic surfactant.

245. The composition of claim 244, wherein the hydrophobic surfactant is selected from the group consisting of octanethiol, dodecanethiol, dodecylamine, tetraoctylammonium bromide, and mixtures thereof.

246. The composition of claim 223, wherein the multiply amphipathic polymer is linear or branched.

247. The composition of claim 236, wherein the polymer is branched.

248. The composition of claim 247, wherein the polymer is hyperbranched or dendritic.

249. The composition of claim 223, wherein the hydrophobic regions of the multiply amphipathic polymer are each comprised of at least one non-ionizable, nonpolar monomer unit.

250. The composition of claim 223, wherein each of the hydrophobic regions comprise at least one monomer unit selected from the group consisting of ethylene, propylene, alkyl (C_4-C_{12})-substituted ethyleneimine, an alkyl acrylate, a methacrylate, a phenyl acrylate, an alkyl acrylamide, a styrene, a hydrophobically derivatized styrene, a vinyl ether, a vinyl ester, a vinyl halide, and a combination thereof.

251. The composition of claim 250, wherein the hydrophobic regions comprise at least one monomer unit selected from an alkyl acrylate, an alkyl methacrylate, an alkyl acrylamide, and a mixture thereof.

252. The composition of claim 223, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise at least one monomer unit containing an ionizable or polar moiety.

253. The composition of claim 252, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable moiety.

254. The composition of claim 253, wherein the ionizable moiety is selected from the group consisting of carboxylic acid, sulfonic acid, phosphonic acid, and amine substituents.

255. The composition of claim 249, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable or polar moiety.

256. The composition of claim 255, wherein the hydrophilic regions each comprise at least one monomer unit containing an ionizable moiety.

257. The composition of claim 256, wherein the ionizable moiety is selected from the group consisting of carboxylic acid, sulfonic acid, phosphonic acid, and an amine substituent.

258. The composition of claim 223, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise at least one monomer unit selected from the group consisting of a water-soluble ethylenically unsaturated C_3-C_6 carboxylic acid, an allylamine, an inorganic acid addition salt of an allylamine, a di-C_1-C_3-alkylamino-C_2-C_6-alkyl acrylate, a methacrylate, an olefinically unsaturated nitrile, a diolefinically unsaturated monomer, N-vinyl pyrrolidone, N-vinyl formamide, an acrylamide, a lower alkyl-substituted acrylamide, a lower alkoxy-substituted acrylamide, N-vinylimidazole, N-vinylimidazoline, a styrene sulfonic acid and an alkylene oxide.

259. The composition of claim 258, wherein the hydrophilic regions each comprise at least one monomer unit selected from the group consisting of acrylic acid, methacrylic acid, styrene sulfonic acid, acrylamide and methacrylamide.

260. The composition of claim 223, wherein the hydrophilic regions of the multiply amphipathic polymer each comprise a vinyl monomer substituted with at least one hydrophilic moiety selected from the group consisting of a carboxylate, a thiocarboxylate, an amide, an imide, a hydrazine, a sulfonate, a sulfoxide, a sulfone, a sulfite, a phosphate, a phosphonate, a phosphonium, an alcohol, a thiol, a nitrate, an amine, an ammonium, and an alkyl ammonium group -$[NHR^1R^2]^+$, wherein R^1 and R^2 are alkyl substituents.

261. The composition of claim 260, wherein the hydrophilic moiety is directly bound to a carbon atom in the backbone of the multiply amphipathic polymer.

262. The composition of claim 260, wherein the hydrophilic moiety is bound to a carbon atom in the backbone of the multiply amphipathic polymer through a linkage selected from the group consisting of alkylene, alkenylene, heteroalkylene, heteroalkenylene, arylene, heteroarylene, alkarylene, and aralkylene.

263. The composition of claim 223, wherein the multiply amphipathic polymer is a copolymer of a hydrophilic monomer selected from the group consisting of acrylic acid, methacrylic acid and combinations thereof, with at least one hydrophobic alkyl (C_6-C_{12}) acrylamide monomer.

264. The composition of claim 263, wherein the multiply amphipathic polymer is poly(acrylic acid-co-octylacrylamide).

265. The composition of claim 223, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 500 to 50,000.

266. The composition of claim 265, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 1000 to 10,000.

267. The composition of claim 266, wherein the multiply amphipathic polymer has a molecular weight in the range of approximately 1000 to 5000.

268. The composition of claim 264, wherein the poly(acrylic acid-co-octylacrylamide) has a molecular weight in the range of approximately 1000 to 5000.

269. The composition of claim 223, wherein the hydrophobic regions represent in the range of approximately 25 wt.% to 90 wt.% of the multiply amphipathic polymer.

270. The composition of claim 223, wherein the multiply amphipathic polymer is a polypeptide in which the hydrophobic regions are comprised of at least one hydrophobic amino acid and the hydrophilic regions are comprised of at least one hydrophilic amino acid.

271. The composition of claim 223, wherein the multiply amphipathic polymer is crosslinked.